Laboratory Practices in Earth Sciences: Landscape Mapping

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Week- 02
Lecture- 06

Welcome back. So, in this lecture we are going to quickly look at what is stereoscopy and why it is important and we will also look at the type of cameras which are used in collecting the stereo photographs and as well as about one or two cameras which are been used and how actually the data is been collected through the satellite. Stereoscopy as I have mentioned a bit in the previous lecture helps us in getting the 3D perspective view of the terrain. So, let us look at what exactly this stereo world is, originates from Greek and means relative to space actually. So, earlier usually we were using this word and this is commonly used for the stereo sound and all that. So, when we talk about the stereo we usually refer to stereophonic sound.

So, originally the term was associated with stereoscopic pictures which were either drawn or photographed. So, in order to avoid the confusion with the stereophonic sound we often talk about the 3D picture. So, instead of calling the 3D picture as like and having the confusion between the stereophonic and stereoscopic pictures it is usually we started using 3D pictures. And in the last decade or maybe more than that there were television screens which used to come when we say that we can view the picture in 3D films actually mainly.

So, we used to have the goggles of the different color eyepiece and then that can be used to have the 3D films to be viewed in. So, basically this is the word which we are using . We are using stereoscopy as it stands for three dimensions. So, further if we look at the more details about that. So, basically what we are doing is that we are viewing the image on the photograph which is taken before and by forward and after cameras either by the satellite or even if you try to look at it using the UAVs that also show. So, for example, this is your right eye and this is your left eye.

So, what you are viewing is this object here which is taken by either the same camera, but at different angles covering the similar area. And as we have discussed in the last lecture that while if you are having the flight then you have like 60 percent of overlap over here. So, this should be your 60 percent of overlap. So, that will give you an advantage to view the terrain in three dimensions. So, what we are doing that we are not viewing.

So, if with the right eye you view the right image and with the left eye you view the left image. Then and then what you will see is that you will be getting the pseudo stereoscopic

model in your brain and that will give you an idea. So, a pair of stereoscopic photographs or images can be viewed stereoscopically by looking at the left image with the left eye and the right image with the right eye. And this is what you can do using the stereoscope also or you can use what we can say the different color glasses. So, that will help you in viewing this.

So, this is what we call stereoscopy. So, the eye base at. So, this is your eye base actually. So, this will be your eye base. So, the eye base and the photobase must be parallel in order to view the stereoscopic model.

So, that should be there. So, that one can do even. So, as I said, you can use the stereoscope that I am going to come to the next slide in, or you can also use your normal eyes to view this, but that needs practice. So, basically what we are doing is that the lens of the human eye projects two slightly different pictures onto the retinas which are then transformed by the brain in a perceptual representation. And this actually is what we are talking about in getting a stereoscopic image.

So, the actual stereographic perceptual observation is a result of this perception through both the eyes. So, you need to have it if you just close down your one eye and then try to see the right image and then the same you can do for the left and then open both you will be able to see the 3D using stereoscope. So, for example, this is an and if you have one practice and if you have good practice in viewing this you can view this image again in three dimensions. But at least you need two photographs of the same object taken at different angles. So, for example, this is the terrain again this is your low angle low oblique aerial photograph and this is again the same, but capturing the same area.

So, if you have an overlap here and this is mostly almost major overlap we can see because you have this portion which has been seen here and this hill is seen over here. So, this and having more than 70 to 80 percent overlap, but this was taken using the digital camera and through the aircraft. But this can again help because both the photographs have been taken by the same camera, but at different angles. That is your view angle, what we are talking about. So, that can give you again the three-dimensional view of the terrain. Now, the advantages of stereoscopy if you take has an ability to extract three dimension information example classification between the elevation difference tall trees or low trees you are having terrestrial features such as height of the terraces these are all fluvial landforms which we are going to talk in next lectures, coming lectures with what are the different landforms and all that.

You will be able and even you can have talk about the slope gradient you can extract the slope gradient if you are having, but with the help of the stereo photos you will have to

generate plus the DEM or you can say DSM that is digital elevation model and digital surface model and this will help you in generating or extracting I would say extraction of topographic information. As well as you can do mapping of landforms with different elevation. See this you can do very easily if you are having the mainly the stereo or you can say the 3D image and as I told that this is all going to be now in digital platform. So, you can extract this DEM in digital form. Then as I said that along with the landforms here this is again related to the river landforms you can prepare a detailed geomorphic map.

So, extraction of topographic information mapping of landforms will be like what you are going to talk about the mapping of the morphology of the surface and that is what we call geomorphology. You can also if you have the almost vertical photographs you can map the strike in depth of the strata that have also been exposed on the surface. Now, the type of stereoscopes if you take this is the latest one is pocket stereoscope, usually what we call and the pocket stereoscope will have just two lenses. So, you can adjust this, these are adjustable and you can fix this adjustment can be like you can move out and in there depending on your eye base. So, depending on the eye base you can do that and then you can put the photographs here.

So, one photograph has been kept here another is been kept here and you can view the 3D in this. So, this is one that is what we call pocket stereoscope. So, what we have here is the plano convex lenses. So, these are all the lenses that we are having are the plano convex lenses mounted. So, it is very like a commonly used pocket stereoscope.

So, usually if you are having the stereo photographs you can carry it in the field and then try to view the terrain in three dimensions. And then we have another one, the mirror stereoscope. So, what it has here is that you have the two fixed mirrors. So, on this side they are actually having mirrors here. So, you have the two mirrors here one is this one and this another one.

So, it consists of two mirrors fixed at an angle of 45 degrees. So, this angle is 45 degrees. So, this is another mirror here and that and those are supported by the 4 lakhs and at the eyepiece two prisms. So, over here in this two prisms or small mirrors are fixed at an angle again at 42 degrees 45 degrees. So, the advantage is that one can view the terrain or the photo in a wider perspective.

So, mainly you can have more area, you can view more area when you are using the mirror stereoscope. You can also change the eyepiece resolution and you can have something like 2 x or 3 x something like that. So, you can have so that will help you in magnification. That can help you in magnifying or magnifying the area of interest that you can do. Given this what you have you can see here the calibrating rod has been shown here.

So, this is also used to do appropriate measurements in terms of the distance, in terms of calculating the height of the object and all that can be done. So, this is an advantage of having the mirror stereoscope. And also, the last point which has been shown here is that you can do what you can do is you can put the tracing sheet on one of the photographs and then trace your features very easily. So, you can side by side manually you can prepare your maps depending on what information you want to extract out of this. So, this is the difference between the pocket and the mirror stereoscope.

Now the procedure for aerial photograph interpretation is the most important is that you need to have the overlapping aerial photograph. And unless and until you are not having this you will not be able to view the 3D. And then to identify or locate the principal point on each photograph. Then draw the straight line passing through each of the principal points. So, if you have for example, you have one photograph here and this we have discussed in the previous one also I will just try to explain quickly.

So, if suppose you are having one photograph and then followed by another one and of course, you have like what we were talking about that you are having like 60 percent of overlap over here. This is one very important point that goes over here. But the other part was what we were talking about in the previous lecture about the fiducial mark, fiducial axis and all that. So, if you draw the fiducial axis y and x, y and x here you get a point here this is your principal point. So, this is saying this is your photograph p over any number you can give.

So, for example, like A1 we are giving here and this is A2 here. So, this will be your principal point 1 and this will be your principal point 2. So, when you connect this actually then that will give you the line of light. And also, the place the photograph on the desk this is this I we will we have talked about this, but the other point is left out is place the photograph on the desk one overlapping the other with about 2 inches between the corresponding image using a straight edge or the scale edges the central line to common line. This is because if you adjust these properly these 2 points and all that will help you in getting the 3D.

Suppose your line of light is coming something like this then in that direction you will have to adjust your photographs. But in this case since it is all, both the points are in the center. So, this will be your line of light here. So, for 3D also, if it is slightly tilted then maybe you will have to put your photograph something like this both the photographs and then you have to view the photographs. So, this can be done easily when you are using the stereoscope.

But as I said, nowadays we have an advantage of putting everything on a digital platform and can be used. So, if stereoscopic vision is not obtained, slowly slide one of the photographs and try to make it oriented at least align the established line that is your line of light. So, that alignment is very important , otherwise you will not be able to see the 3D image. And one can also try to align the object. So, you can fix up one of the things like try to focus on one of the objects and try to match that object in other photographs also that can be easily done.

Now, coming to the principal point which I have explained over there. So, you have x and y axis and if you connect the fiducial marks that will give you the intersection will give you the point and that point is your fiducial mark. So, sorry this is your principal point. So, for this you have the principal point is this one for this image and this image the principal point is this one. Now, sometimes it is also felt that you need to have conjugate points to have better alignment and understanding or you can say that identifying the line of light.

So, for example, for image 1 this is your principal point for image 2 this is your principal point. And then when you you are like you you can you can do one thing you can trace out this point here and then with the maybe at the same time what you can do is you can just mark one of the the object here or the landform and with the same you can with this you can move your sheet or tracing sheet on the other image. And then you will see that the principal point of the second photograph will not match the principal point of the first photograph. Because there is a difference while taking the photograph they are taken by different times and different angles. But viewing the similar area or the I would say the same area.

So, when you do that, this point may lie somewhere over here and that will be your conjugate point. So, this is the conjugate point similarly you can do it for the other photograph also. So, this is the conjugate point of the photograph 2 which has been transferred to your transfer to your first photograph and similarly the conjugate principal point of is transferred to the next photograph will be your conjugate point. So, this is your conjugate point of the first photograph which has been transferred here and this is the conjugate point of the second photograph which is transferred here and this is PP 2 this principal point here and this one is PP 1. So, that is how you can do it and this helps in identifying.

So, when you connect this will help you in identifying the line of light and that is what I was talking about. So, if you have put the photograph straight and you are trying to view like this you will not be able to view the 3D. So, unless and until you have not oriented your photograph to this. So, a line of light will help you at least in understanding what is the sequence in which your photographs have been taken by the flying object. This is one

exercise which you can do by holding your like 2 fingers and bringing them close to each other and at one point of time without touching the finger.

You will find that there is an image which has been formed in the center and that is floating and that is what you are looking at in the 3-dimensional image. So, this way you can practice. So, what you can do is what is shown here. So, you start bringing your fingers like you're bringing your fingers towards each other and the time will come that you will find that this portion of the finger is floating in the center and you have not touched both the fingers. So, this is what the exercise helps you in practicing for the 3D image or you can view the stereo pair and try to see the 3D perspective of the image.

Now, coming to the other part, the camera films what we are having. So, usually those who are aware about the cameras. So, we have lens, shutter and aperture. So, lenses can be characterized by focal length and what we can easily find out with what type of lens and what shutter speed and aperture and all that. But the other point which I am trying to explain to you is that there are cameras and that is what we call frame cameras which will collect the data like when portion wise.

There will not be continuous data here. So, it will keep on clicking the different images in a particular frame. Then you have another what we call the continuous strip cameras. So, these were frame cameras. So, you have one frame here, second here, three here like that, but this one is continuous. So, continuous strips will keep on recording your data.

And then you are having a panorama. So, panoramic will definitely be what you were discussing, but we will have distortion in. So, the data which will be collected will be something like over here. So, you will keep having the strips going in this direction. But so, I will try to put it later in a better way. So, you are having the film here and this is the area which has been and then the second one will come somewhere over here like this.

But this so this will be basically collected in strips again, but in taking the panoramic view of the region. And another one is mostly used for not what we were talking about in the stereo photos. So, this is what you have the forward camera and you are having the after camera. So, the forward camera is taking photographs of this area. So, you have the photograph of this area where it is taken by this one forward and after you are taking this one.

So, this is basically the camera used to collect the corona photographs which I was talking about. So, as you move further keep moving further then you keep on taking the photographs of the same area which has been taken by forward and then here what is been taken. So, already this area was taken by the forward image and then it was taken by the

after image. So, if you fly , keep the satellite keep on flying like this and you keep collecting the data over here.

So, this is the part of the corona photograph. Now, corona photograph resolution is like the data comes in something like this. So, you have the strips here collected by the forward and after camera and they come in negative and you can have the you can enlarge it and print it. So, what we do is that after knowing the line of light and all that so, at least what we do. So, in the previous one it has been if I am not wrong it is right now yeah it has been shown here.

So, this is your Nadar point here. So, you have a long way away from the Nadar and there will be some distortion. So, for example, this is the Nadar here and this one is Nadar. So, this will perfectly be almost vertical here. So, what we do is to have at least the 3D image. So, we try to develop the photograph covering the same area and we obtain the paper print and that can be viewed in your like hard copies you can use that.

So, you will have again what you can do with it. So, the area the size of the negatives are 5.5 centimeter to 75 centimeters. So, this is 5.5 and this one covers almost like 75 centimeters you have. And the area covered along the width is around 17 kilometers by and total if you say and that is around 230 kilometers of the area is covered here.

Then this is what we are having the corona image which is developed from the negative. So, you can have a very high-resolution image of the sukim. And this is what we have a mosaic number of images and to view the terrain and overall. See this is what we are looking for is a 2D actually 2D image, but if you have the similar like after and forward photographs of the same area you can view this in 3 dimensions also.

So, this is what one can use. So, the distance here if I am not wrong is this is an enlarged photograph, but the distance between if you have to quickly view this. So, distance between these 2 points for example, if I take the same points then that should be around 6 inches or so. So, that can be done. So, for those who are having good practice of viewing the 3D image or viewing the stereo images with the naked eye then this distance is fine. So, then one can view this in 3 dimensions easily or even you can use the stereoscope pocket stereoscope and try to view this in 3 dimensions.

For publications also we try to use this. So, once this image you see in 3 dimensions then you will be able to map this very easily either on the digital platform or you can use it by using the tracing sheets and all that. So, this is the stereo pair of corona photographs. Now, the data which we are using now and which is very much like I would say that it is robust and in terms of the data quality and very high resolution and available. So, on a digital

platform. So, of course, what you are able to see is a slightly reddish color also in this.

This is exactly what we have prepared is anaglyph. We will come to this and this is one lab which we have planned and which we will share the data with you and we will ask you to do that if you are having those software's, but at least you will be able to learn how we are generating this. Now, simply in this image you can use the filter glasses and that can help you in generating the 3D on your screen. So, corona is the previous one of corona and this is cartosat 1 you can buy this from NRHC Hyderabad. So, per scene it varies from after and the forward and after image. So, the area which has been covered in one scene is around 26 to 30 square kilometers, resolution is around 2.

5 meters. It has the stereo vision capability and the photographs which are available are orthorectified. So, these are all advantages that we are having with the carto set data. And mostly we will use cartosat data as well as we will show you some data which is collected by the UAVs. So, with this I end here and see you in the next lecture where we will talk about the relief displacement and how we can calculate the height if you are from a single photograph and we are having the principal point and all that.

So, we will talk in the next lecture. I hope you enjoyed it. Thank you so much.